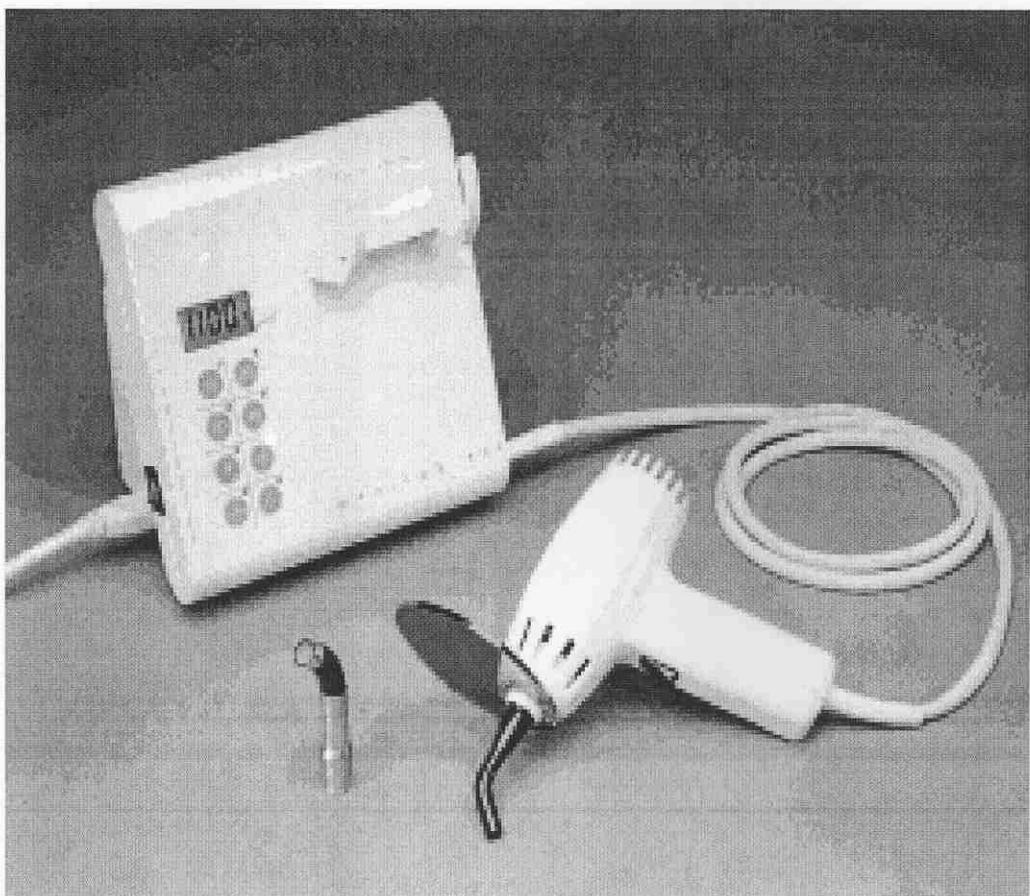


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OPTILUX 501 SERVICE MANUAL

OPTILUX 501

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Technical Description

The Demetron 501 is a dual microcontroller design. One micro (87L88CF) is used to regulate the lamp output, monitor line frequency, zero crossings, and sample a voltage feedback circuit. Since this micro has a multi-input A/D converter, it also digitizes a radiometer circuit output. In the 501 the 87L88CF is used as a slave device for voltage and frequency control. A second micro (87L88RW) controls all other functions. The circuit components are mounted on a printed circuit board attached to the front plastic housing in the control unit

Two levels of lamp output power are used in this VCL 501 curing light. The regular mode keys; are 10, 20, 30, 40 seconds and CCC, use a lamp voltage of 11.75V and function in a similar manner to the same keys used in the VCL 500 curing light. The programs generated by the other keys consist of a ramp followed by a full output for the key program duration at 12.25V.

The special key functions are **Ramp**, **Boost**, and **Bleach**. These key functions are described below.

Ramp: This key provides a program consisting of an exponential ramp for 10 seconds followed by a high output (12.25V) for a further 10 seconds. The ramp is designed to reduce composite shrinkage by irradiating at 100 –150 mw/cm² for a few seconds before ramping up to full curing power.

Boost: This key provides a program consisting of a linear ramp followed by a high output (12.25V) for 10 seconds. There is a beep at 5 seconds then a beep off at ten seconds. This program is designed to provide a high output curing cycle to reduce curing time.

Bleach: This key provides a program consisting of a linear ramp for 1 second followed by 30 seconds at high output (12.25V). This program was designed to be used with light activated bleaching compound for whitening teeth.

Power Supplies

The secondary winding of the transformer provides the lamp with AC power, which is regulated by controlling the firing angle of two mosfet switches. This AC voltage is also half-wave rectified (D1), filtered (R35, C2, and C3), and applied to the input of a linear 12v regulator (VR1) to provide 12 vdc for the system (fan, beeper and trigger circuit for the mosfets). This 12vdc is further regulated down to 5vdc (C22, C4, VR2, C20, C21) to provide 5v system power.

Frequency Monitoring

The normal frequency is determined during the power up sequence (either 50 or 60 Hz) to change from one to the other requires the controller to be powered down then up.

Upon power up the system takes two seconds to determine the line frequency, if the frequency is outside of the limits shown below, the system will continue to perform two-second checks. If the trigger switch is pressed to start a curing cycle during this time the beeper will sound and an EE5 error will be displayed. If the frequency is outside of the limits, the lamp will not turn on. The beeping will continue until the trigger switch is released. Pressing the trigger switch again will re-cycle the limit checking.

The microprocessor control is a digital system that requires zero crossing signals for timing control. Loss of the signal or a frequency outside of the window limits will cause the lamp voltage regulation to fail. Therefore under these conditions the lamp will be turned off.

If the curing light has been turned on and a frequency change exceeds the window limit, the lamp will turn off and the beeper will sound continuously until cancelled by either pressing the trigger switch or turning the unit power off. When the frequency returns to within the window limits the lamp can be turned on again by pressing the trigger switch, under these circumstances the timer is reset and the entire curing time will be obtained.

Line voltage Range	92 to 132v 50/60 Hz
Frequency Range 50 Hz	47.5 to 52.5 Hz
Frequency Range 60 Hz	57.0 to 63.0 Hz

Zero Crossing

R2 couples the transformer secondary waveform to the input of the zero crossing detector, (U1C and U1B). D2 and D3 clamp this voltage to 5vdc and ground. C25 provides a slight delay in the zero crossing which will be compensated for by the micro 87L88CF in accordance with the voltage set on its pin 13 by (R34 and N2-1, 4). R3 and R4 provide a variable reference to U1C, and 0v on the positive to negative AC transition, and 5v on the negative to positive. This insures that the negative transition will be jitter free (Hysteresis via R4) and that the positive transition will be offset from 0V by 5V. It is the negative crossing that is used for system timing and voltage control. R5 and R6 provide a 2.5V reference for U1B. The zero cross signals can be seen at TP7, this signal is then applied as an interrupt to pin 39 (U2).

Watchdog and Reset

The 87L88CF (U2), has an internal watchdog circuit which is output on pin 40 (U2). This output requires a pull-up resistor (N1-2). This output will go high if the program does not service the watchdog at the proper time (i.e. not running properly). This signal is inverted by U3-D and or'ed into the reset circuit by D9. Zero crossing is also or'ed in by D10. With normal zero crossing, C15 is continuously discharged by D4. Either watchdog or zero crossing failure will cause a reset. This reset signal turns on U4-2 (pin 15); which is the reset input for both microprocessors. Power up reset is controlled by U6, which is a low voltage detector. R16 is a pull-up for this line, and C23 bypasses any noise on this line.

Mosfet Drive and Voltage feedback

A variable pulse width, positive going signal is generated at pin 42 of U2. This signal is fed to pin 7 of U4 (2.4v square wave when lamp is triggered on). This signal is then amplified by U4 and the output signal on pin 10 (5.6v square wave) is sent to the base of Q1. This signal controls the turn on point of the mosfets (Q2 & Q3) for each half cycle of the secondary waveform. R10, C8, D5, R12, C9, and D6 form snubber circuits for the mosfets. R11 is required for fast turn off of the mosfets at zero crossing.

The feedback section of the circuit consists of a differential amplifier and associated components. Since the lamp is not ground referenced, the differential amplifier (U1A) is used to generate a feedback signal for the negative going half cycle. R21, R29, C10, R15, R23, C19, D4, D8, D11, and D12 are used to attenuate, filter and clamp the feedback signal before it is fed into the differential amplifier. R13 and R14 set the gain of the amplifier. C26 is used to provide some high frequency roll off. When pin 3 of U2 is high, the unit is in Boost mode. In Boost mode, R24 provides a small offset current to increase lamp voltage. The value of R24 will dictate the amount of Boost. The feedback signal can be checked at Test Point 10.

Voltage Control

At power up reset, U2 measures the zero cross to determine the line frequency. The frequency must be 60Hz or 50Hz $\pm 5\%$, if it is outside the limits, an EE5 error will occur. The EE5 error will continue to appear until the frequency falls within the limits.

In response to a trigger switch input, the selected program starts a ramping routine which is an open loop. This brings the RMS voltage to the lamp safe limit (high line, high frequency), then the controller enters closed loop mode. In this mode it begins to regulate based on the feedback signal. An A/D converter samples the feedback, the RMS voltage is determined, the error calculated, and the corrected gate time is output. This process continues to occur throughout the rest of the program.

Two lines of communication exist between the master 87L88RW and slave 87L88CF the start pin 28 (CF) and the error pin 32 (CF).

Radiometer

The output of the radiometer circuit is digitized by the slave micro and the data is sent to the master using five lines, four bits and a nibble status line for a total of 8 bits; pin 43 (LSB), 44, 1, 2 (MSB), pin 21 (nibble status) of (U2).

The radiometer data is read on pins 19, 20, 21, and 22 of (U8). Diodes D14, D15, D16, D17 are used to isolate radiometer data from the switch array at all other times.

Beep mode

Just after power up reset, the status of the beep mode switch (SW2) and the Lamp timer reset switch (SW1) are strobed onto the communication lines (U8 pins 19-22) by a low going strobe generated at U8 pin 2. Pin 2 is tied to the common of the two switches.

Trigger and fan circuits

To allow for the use of the different wiring schemes utilized in the various Demetron guns, the 501 employs an Opto Isolator (U5); this component allows either polarity trigger. In the 501 operation is as follows: when the system is not in use, J7 is pulled up to +12vdc through R22. This voltage passes through the low impedance of the fan motor, to the trigger switch. The other side of the trigger switch is connected to J6 and to pin 1 of U-5.

Pin 2 of U5 connects to +5vdc through R18. J5, the fan and switch common, is tied to four open collector segments of U4 (pins 11-14). These transistors are all off when the fan is not running. Under these conditions, when the trigger is pulled, J6 goes to +12vdc. This triggers the output side of U5 (pin 3 goes high). This signal is inverted by U3-C and goes to U8 pin 30, which begins the selected curing program. When the fan is triggered by pin 42 of U8 through the four segments of U4, J5 goes from +12vdc to ground so that subsequent closings of the trigger switch puts ground on J6. This is the opposite polarity of the original trigger, but remains the trigger polarity as long as the fan is running. C14 is required to prevent these polarity changes from causing extraneous triggers.

The fan run time is proportional to the lamp on time. The fan will continue to run after the lamp has been turned off, time is accumulated in 10-second intervals. A normal fan run time is 10 seconds longer than the lamp on time, with a max of 150 seconds. If a lamp is turned on before the previous run time is completed the remaining run time is added to the new run time.

EEPROM

The EEPROM is used to store elapsed lamp hours and a checksum to verify proper operation. The elapsed time is read from the EEPROM on power up and displayed on the LCD. New values are written to memory at the end of any curing cycle.

LED Key Display

The D port of U8 (pins 53-60) is used to drive the keypad LEDs directly. Three of these outputs, pins 58, 59, and 60 are used to signal special lamp control modes back to U2. Pin 58 = ramp mode, 59 = burst mode, 60 = bleach mode

LCD and Keyboard Drive

Twenty-six output pins are used for the LCD display, 25 segments and 1 common. The signal on the common line, pin 33 of U8, is a 50hz square wave of 5 volts amplitude. To provide the best contrast for the display, all of the segments of the display are driven directly from the I/O pins of U8. A segment that is off will have the same phase as the common. Any segment that is on will have the opposite phase. The 50hz common signal is also applied to one column of the keypad, pin 1 of J8, and is inverted by U3-A and applied to the other column, pin 2 of J8. The two columns of the keypad have opposite phase 50hz signals on them. The keypad also has four row lines, J8-3, 4, 5 and 6. These lines are pulled up to +5v through Rn-1 and are the row inputs to U8 pins 23, 24, 25 and 26. The individual keys are decoded simply by detecting which phase is on which input.

Clock Circuit

The 10MHz clock signal required for the two microcontrollers is provided by a common 10MHz ceramic resonator. The resonator uses the internal circuitry of U2 as an oscillator, this signal is then output to U8

Error Codes

The early version of software contained only one error message EE5. The latest version has three messages, EE4, EE5 and EE6.

EE4	Error in writing to the EEPROM
EE5	<ul style="list-style-type: none">Communication error between the master and slave micro. Examples of this are: If there was no 87L88CF plugged in A break in the handshake lineError in regulation that causes the 87L88CF to shut down
EE6	Error in reading from the EEPROM



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SERVICE BULLETIN

OPTILUX 501 REPLACEMENT PARTS LIST MODEL VCL 501

The following is a replacement parts list and related drawings for parts identification used in servicing of the Optilux 501 Model VCL 501. The Optilux 501 should only be serviced by a qualified repair technician.

ITEM NO.	DEMETRON P/N	DESCRIPTION	QTY. PER UNIT
1	901629	HOUSING, REAR	1
2	901719	PLATE, TRANSFORMER	1
3	52094	TRANSFORMER (100-120 VOLTS)	1
	952095	TRANSFORMER (220-240 VOLTS)	1
4	901828	INSULATOR, TRANSFORMER	1
5	30425	SWITCH, ON/OFF (100-120 VOLTS)	1
	30426	SWITCH, ON/OFF (220-240 VOLTS)	1
6	00409	BRACKET, MOUNTING, WALL	1
7	930726	HOLDER, FUSE	2
8	930727	CARRIER, FUSE	2
9	30257	FUSE, 1.60 AMP (100-120 VOLTS)	2
	30246	FUSE, 0.80 AMP (220-240 VOLTS)	2
10	940573	STAND-OFF, DOUBLE ENDED	4
11	930734	PLUG, RECEPTACLE	1
12	930746	CORD, POWER, 2 PRONG U.S.	1
	930730	CORD, POWER, EUROPEAN	1
	930731	CORD, POWER, UNITED KINGDOM	1
	930732	CORD, POWER, AUSTRALIAN	1
	930733	CORD, POWER, JAPANESE	1
13	40343	SCREW, PAN HD., 8-32 X 1/2	4
14	940428	SCREW, PAN HD., 8-32 X 3/8	4
15	940575	SCREW, PAN HD., 8-32 X 1 3/4	4

360683 REV. E

SERVICE BULLETIN NO. 63
DATE ISSUED: 6-09-99

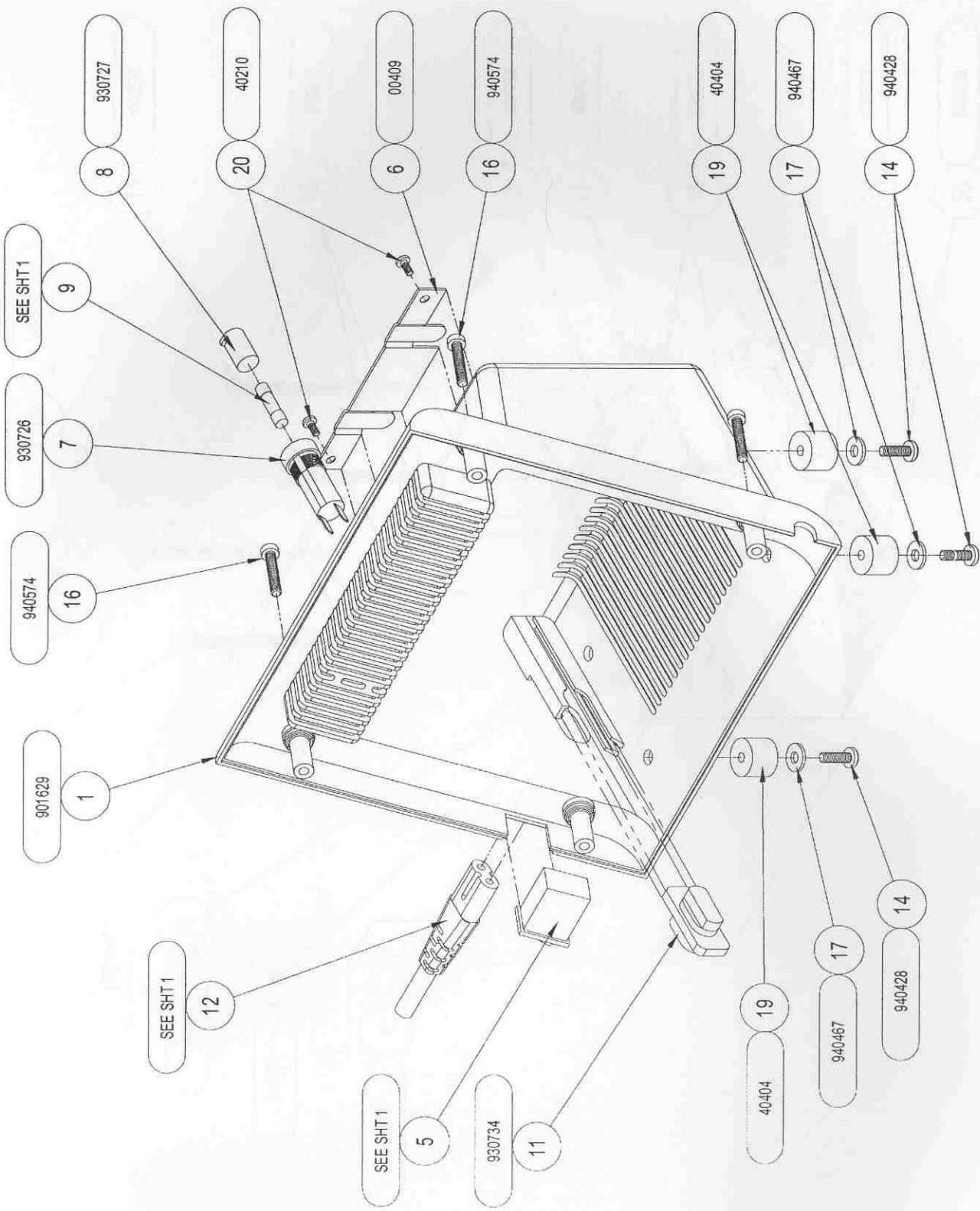
ITEM NO.	DEMETRON P/N	DESCRIPTION	QTY. PER UNIT
16	940574	SCREW, FILLISTER HD., 8-32 X 1.00	4
17	940467	WASHER, FLAT, #8	4
18	940576	WASHER, SPLIT-LOCK, #8	10
19	40404	BUMPER, RECESSED, RUBBER	4
20	40210	SCREW, FLAT HD., 4-20	2
21	921301	ASSEMBLY, BOARD & COMPONENTS, GUN	1
22	20592	ASSEMBLY, BLOWER	1
23	901811	HANDLE, BACK, WHITE	1
24	921287	GUN CORD & TERMINALS	1
25	01436	TRIGGER, SWITCH	1
26	21237	LAMP, REPLACEMENT, 80 WATT	1
27	40391	SPRING, COMPRESSION	3
28	40407	SCREW, PAN HD., M3.5 X 0.6, CAPTIVE	2
29	40415	SCREW, PAN HD., M2.2 x 0.8 x 6.3 LONG	4
30	40457	SCREW, PAN HD., M2.2 x 0.8 x 16.0 LONG	3
31	30181	SOCKET, LAMP	1
32			
33	952214	ASS'Y, HOUSING, FRONT, OPT 501 w/o GUN HANGER, (INCLUDES ITEM 18,37 & KEYPAD, P.C. BOARD & RADIOMETER FILTERS)	1
34	901798	HOLDER, GUN	1
35	940572	SCREW, PAN HD., #6 X 3/8	3
36	901820	SCREEN, 500 SERIES, CSA	1
37	952212	ASSEMBLY, FRONT HANDLE	1
38	20886	ASSEMBLY, LAMP SHIELD (INCLUDES #31)	1
	952253	CIRCUIT UPGRADE KIT	1



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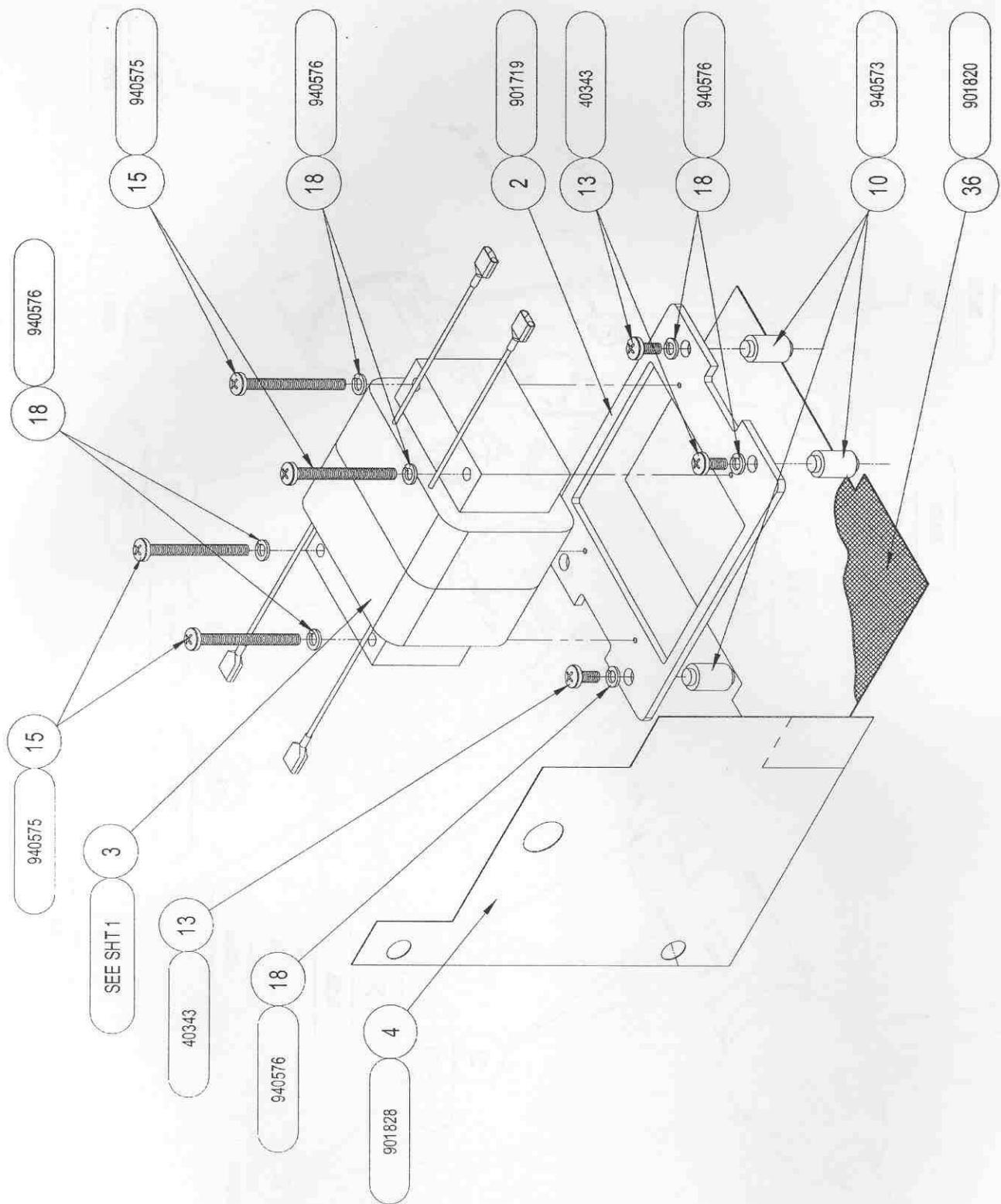
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SHEET 3 OF 6

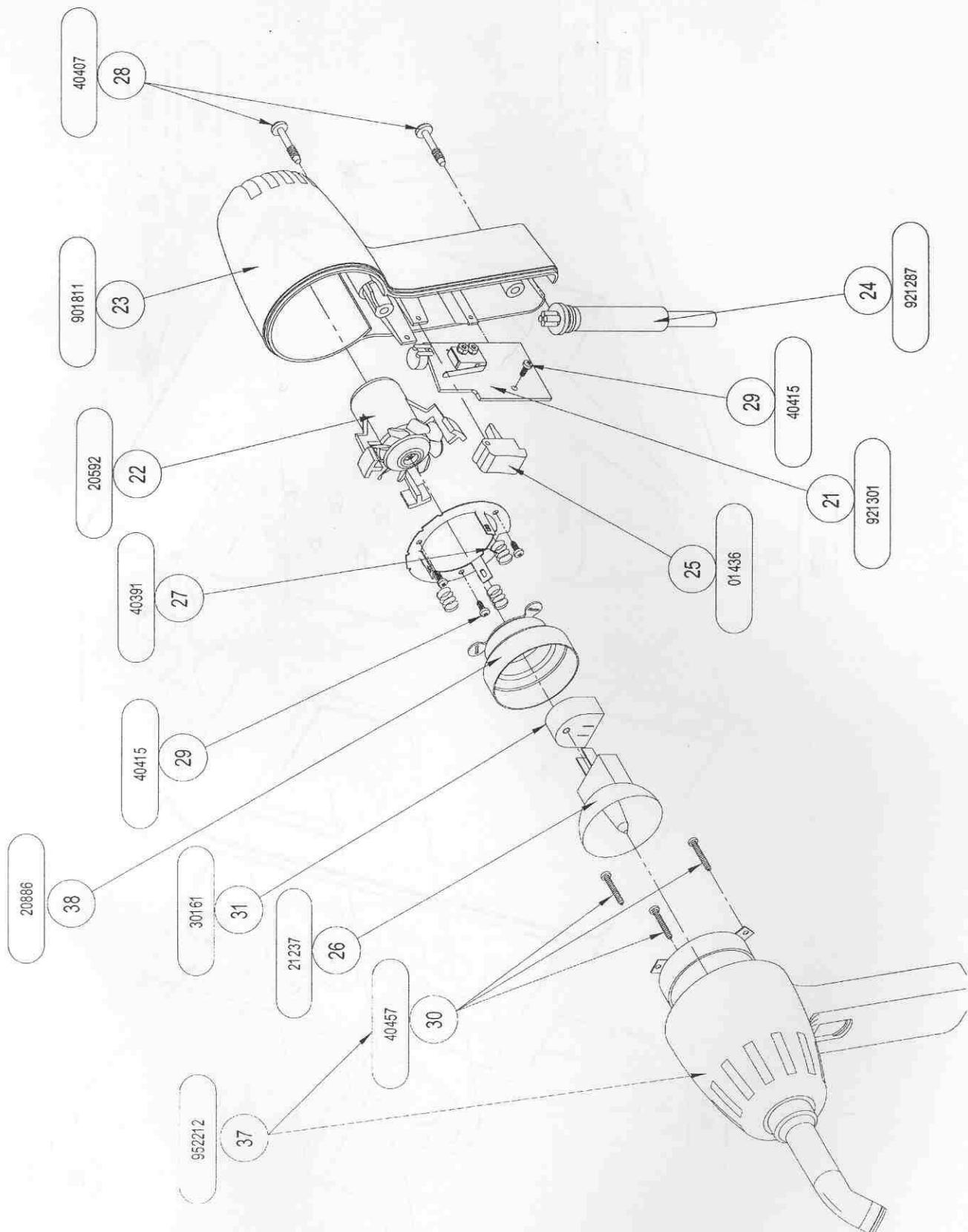


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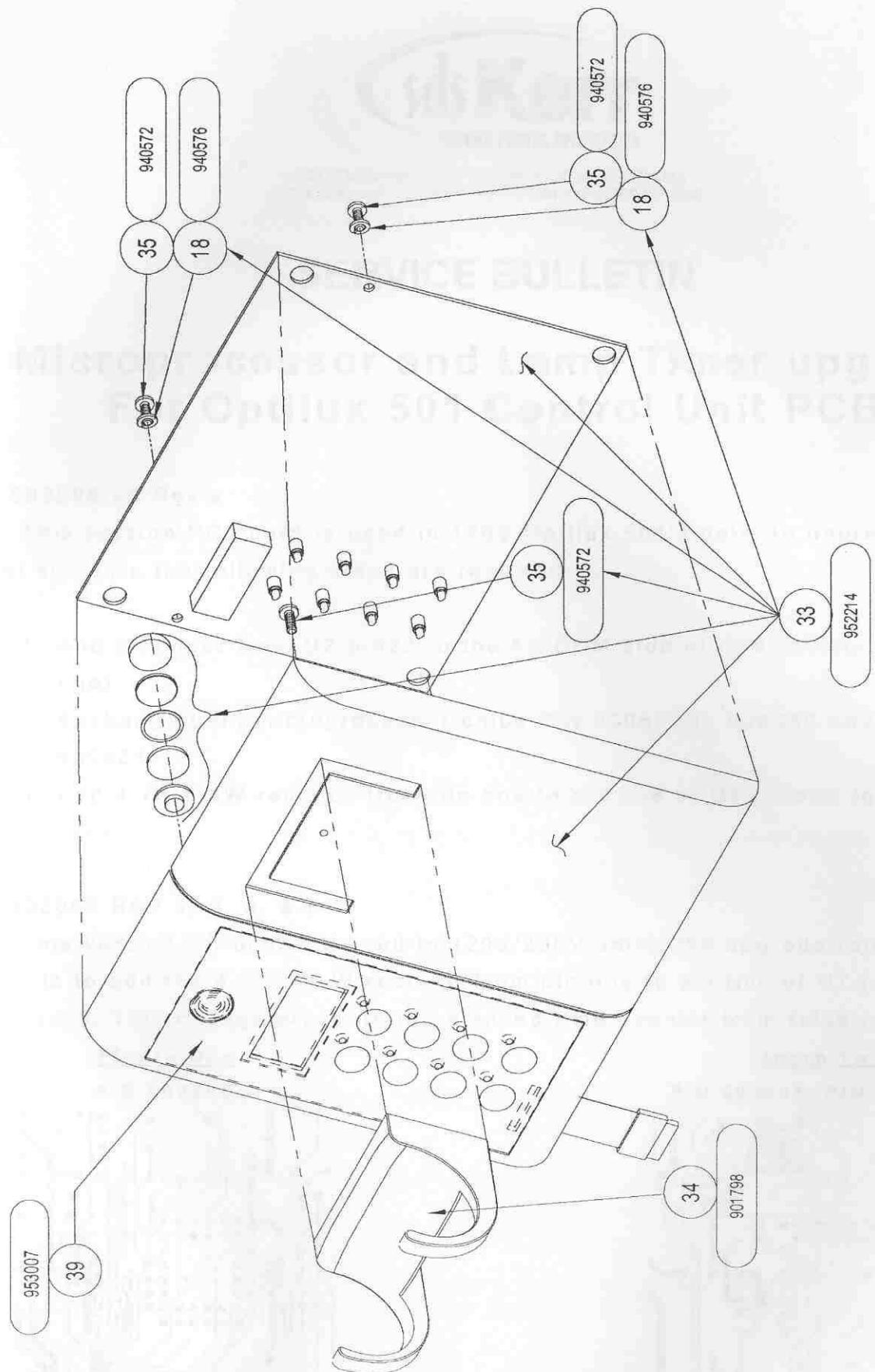
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SERVICE BULLETIN

Microprocessor and Lamp Timer upgrade For Optilux 501 Control Unit PCB

P/N 902008 all Rev's

This version PC board is used in 120V Optilux 501's only, to upgrade to the latest software the following steps are required.

1. Add a jumper from U2 pin22 to the 5V COM side of C99 (shown in figure one).
2. Exchange both microprocessor chips P/N 930557 to 930380 and 930567 to 930881.
3. Add 4.7KΩ ¼W resistor from pin one to pin five of U7 (shown in figure two).

P/N 902065 REV 1, 2, A, & B

This version PC board is used in 120V/230V units, the upgrade required on rev shown is to add the 4.7KΩ ¼ W resistor from pin one to pin five of U7 (shown in figure two). This change prevents the elapsed time counter from false resetting.

Figure One

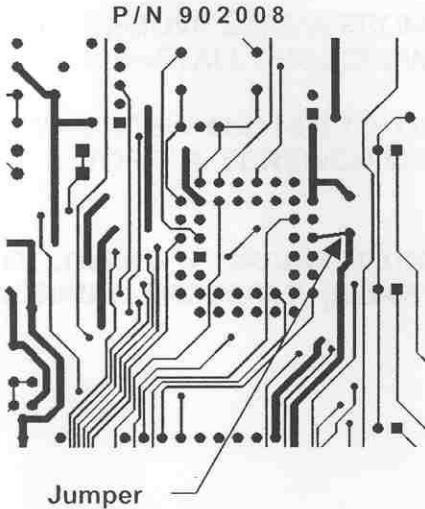
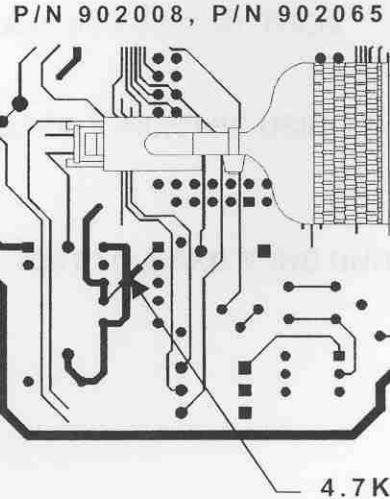


Figure Two

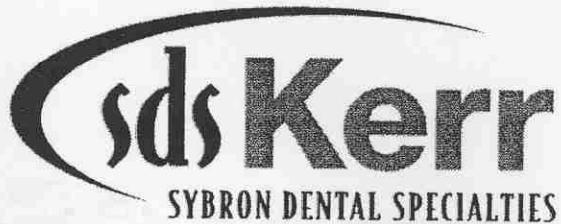


960692 REV.A

Pin 22 to C99

SHEET 1 OF 1

SERVICE BULLETIN No. 66
DATE ISSUED: 02-24-00



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SERVICE BULLETIN

DESCRIPTION: REWORK OF OPTILUX 501 CIRCUIT BOARD ASSEMBLY 990000 AND 990000-0 TO ELIMINATE PROBLEM OF PREMATURE BURN OUT OF LAMPS, IMPROPER TRIGGERING, AND FAILURE OF FET Q3.

APPLIES TO: ALL OPTILUX 501 UNITS.

PROCEDURE:

CIRCUIT UPGRADE: (FIGURE 1)

1. REMOVE CAPACITOR (C1) AND RESISTOR (R1). REPLACE WITH TVS (P/N 931139) AND INSTALL JUMPER ACROSS C1 AS SHOWN IN FIGURE 1.
2. REMOVE RESISITOR (R7), REPLACE WITH 6.8KΩ RESISITOR (P/N 30248).
3. REMOVE CAPACITOR (C16), REPLACE WITH 0.01MF CAPACITOR (P/N 30481).
4. REMOVE CAPACITOR (C25), REPLACE WITH .0047MF CAPACITOR (P/N 930808).
5. REMOVE RESISTOR (R34), REPLACE WITH 17.4KΩ (P/N 930825).

FET UPGRADE: (FIGURE 2)

1. REMOVE SCREW FROM Q3, INSTALL JUMPER TERMINAL (P/N 940724). THEN REINSTALL THE SCREW.
2. SCREW AND NUT ON Q2 & Q3 SHOULD BE TIGHTENED TO 7 INCH/LBS USING A TORQUE SCREWDRIVER.

FOLLOWING UPGRADE OF UNIT, PERFORM A FUNCTIONAL TEST TO MAKE SURE UNIT IS WORKING PROPERLY. (MAKE SURE LAMP TURNS ON)

FIGURE 1

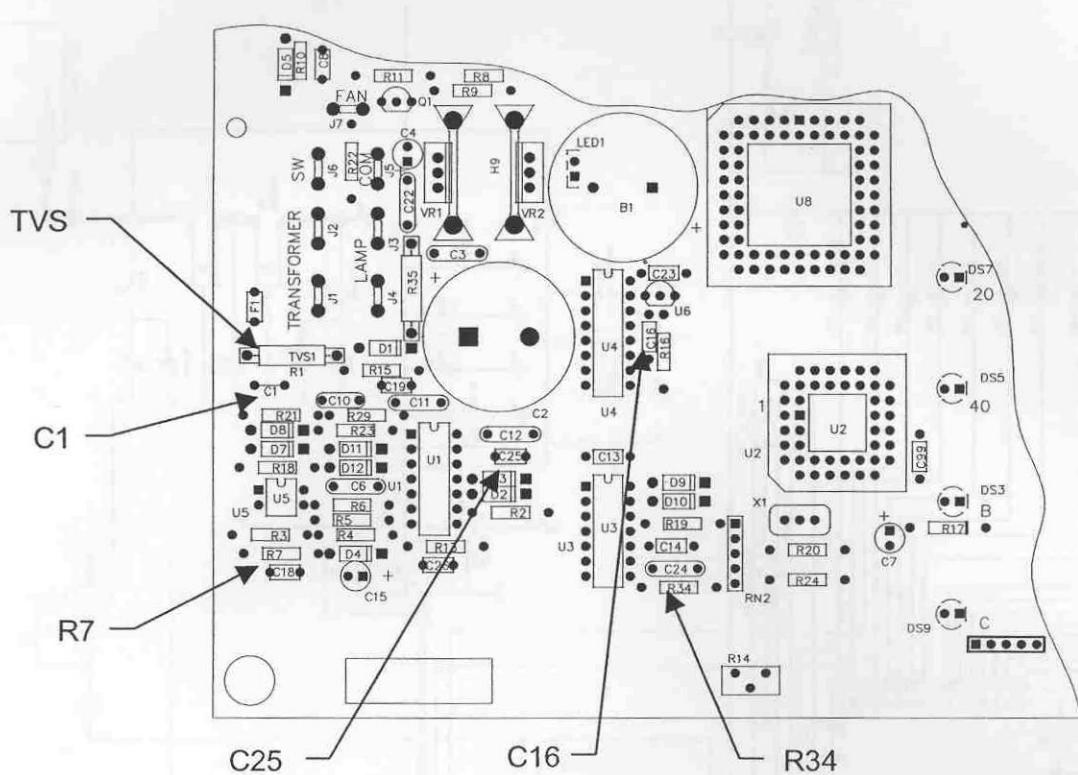
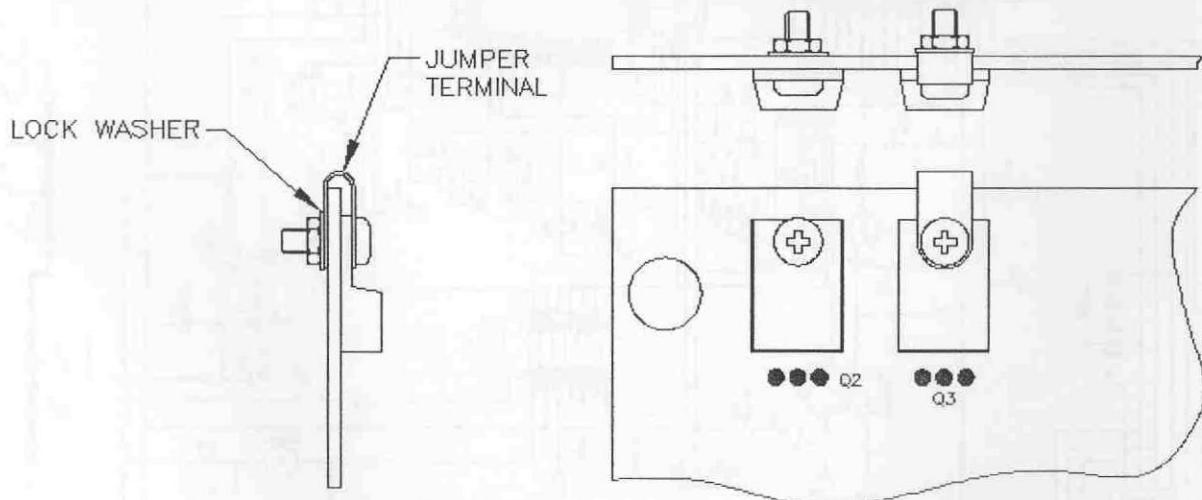
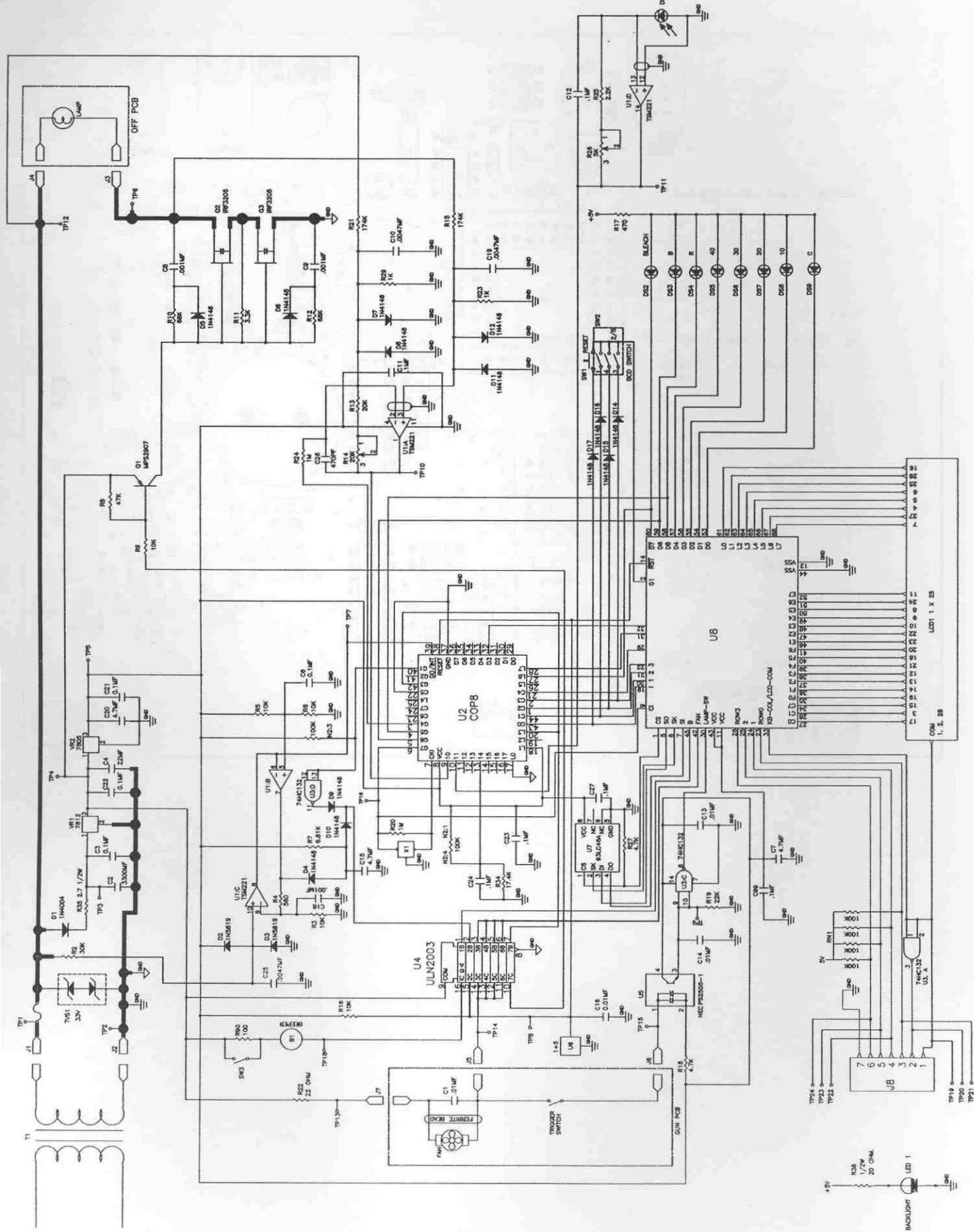


FIGURE 2

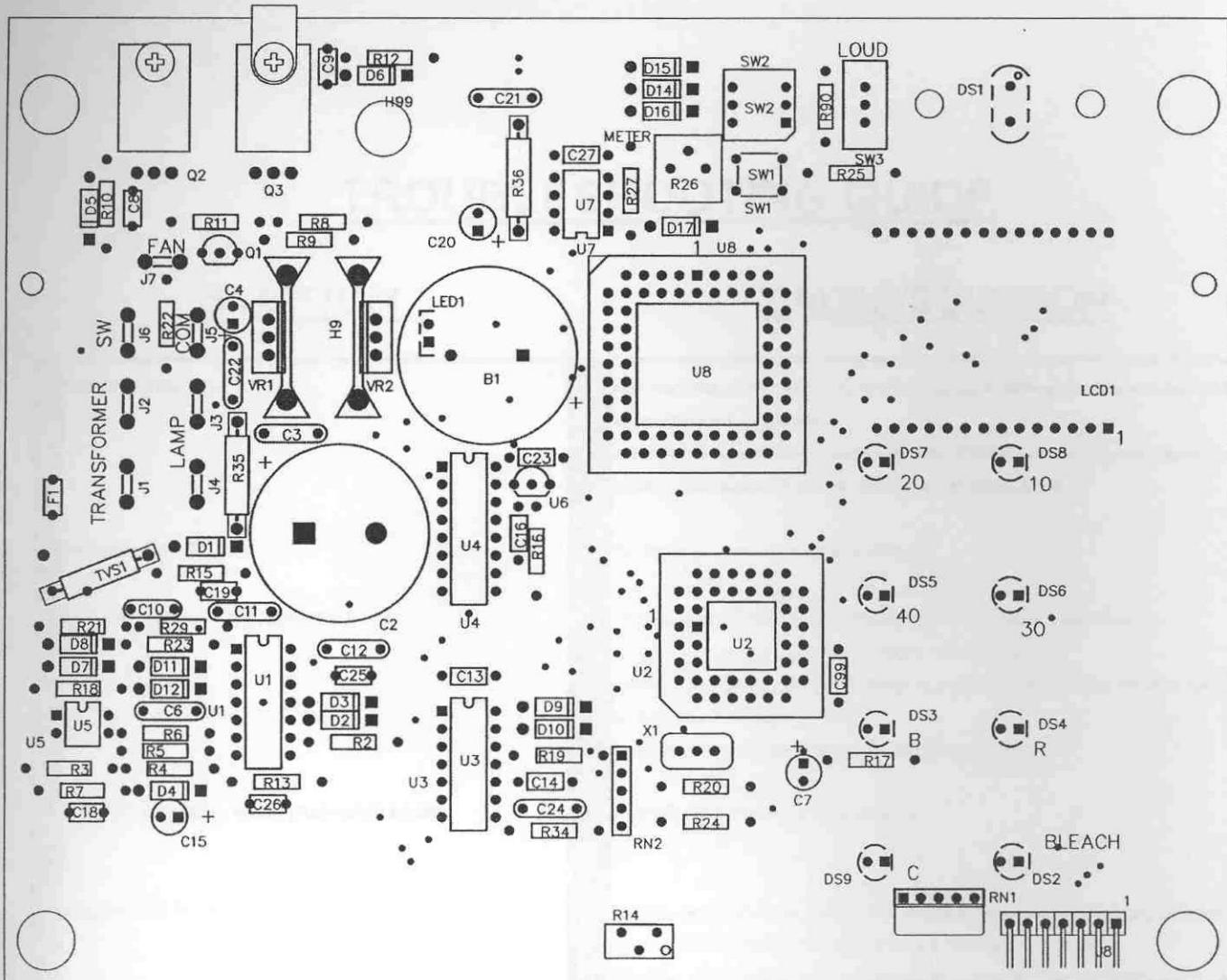


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SERVICE BULLETIN NO. 77
SHEET 2 OF 2



SCHEMATIC, MICROCONTROLLER, OPTILUX 501



ASSEMBLY, BOARD & COMPONENT, CONTROL, OPTILUX 501

TROUBLESHOOTING GUIDE

<u>SYMPTOM</u>	<u>CAUSE/SOLUTION</u>
1. E55 (AT TRIGGER).	<p>1.a After "5.a" RES, 17.4K OHM, 1/4 WATT, 1%, FILM update is performed make sure of continuity to adjacent lands and components.</p> <p>1.b Check the Hardware on P/N 930768 Q2 & Q3 TRANSISITOR, FET s to make sure they are tightened.</p> <p>1.c Install Jumper Terminal P/N 940724 per Engineering Directive N0. 59</p>
2. NO RADIOMETER.	2. DS1 P/N 30046 DIODE, PHOTO, SILICON (bad).
3. NO DISPLAY (WITH BACKLIGHTING).	<p>3.a U6 P/N 930848 MICROCNTR, SUPERVISORY, CIRC shorted (no power-on reset).</p> <p>3.b X1 P/N 930821 OSCILLATOR, CLOCK, CERAMIC, 10MHZ (bad).</p> <p>3.c Check pin 2 of U4 P/N 930804 AMPLIFIER, DUAL, W/DUAL COMPARTR, the or'd signal coming from D9 & D10 P/N 30022 DIODE, IN 4148.</p> <p>3.d Check RN2 P/N 930860 RES, NETWORK, 100KOHM 2%, 5 PIN.</p>
4. ERRATIC BEEPING - NO KEYPAD OPERATION	4. KEYPAD P/N 902115 (shorted/chemical damage).
5. TRIGGERING DELAY.	<p>5.a R34 P/N 930825 RES, 17.4K OHM, 1/4 WATT, 1%, FILM (replaces existing resistor) - C25 P/N 930808 CAPAC, .0047MF, 50V 5%, FILM (replaces existing capacitor).</p> <p>5.b After "5.a" CAPAC, .0047MF, 50V 5%, FILM update is performed make sure of continuity to adjacent lands and components.</p>
6. NO TRIGGERING.	6. U4 P/N 930818 DRIVER, ARRAY, SEVEN DARLINGTON (bad).
7. FAN ON AT POWER-UP.	7. U4 P/N 930818 DRIVER, ARRAY, SEVEN DARLINGTON (bad).
8. CANNOT ADJUST LAMP VOLTAGE (14VAC to 16VAC)	<p>8.a U2 P/N 930880 IC, MICROPRSR, COP8 (bad).</p> <p>8.b R23 P/N 30110 RES, 1K OHM 1/4W 5% FILM (open pad to land line).</p>
9. NO BLEACH/BOOST MODE-NORMAL/CCC	9. Check the right side of R24 P/N 30106 RES, 1MEG 1/4W 5% FILM for continuity of adjacent through hole, C26 P/N 30713 CAPAC, 470 PF 1000V 20% CERM & R13 P/N 930863 RES, 20K OHM, 1/4W 5%